REMARKS

Status of this application

Claims 1-19 and 22-32 are currently pending in this application. In the Office Action mailed on January 25, 2005:

(a) Claims 22-32 were rejected under 35 U.S.C. 112, second paragraph, as being dependent on a cancelled claim.

(b) Claims 1, 9-12, and 15-19, 22-25, 29-32 were rejected under 35 U.S.C. 103(a) as being unpatentable over the article by Arnold et al. entitled "Virtual Teeth for Endodontics Training and Practice" (hereinafter "Arnold") in view of the NASA Tech Brief dated October 1998 entitled "Haptic Technologies' PenCAT/Pro 3D pen" (hereinafter "PenCAT").

(c) Claims 2-8, 13-14, 16 were rejected under 35 U.S.C. 103(a) as being unpatentable over Arnold and PenCAT further in view of Hayka et al Patent 5,688,118 (hereinafter "Hayka").

(d) Claims 26-28 were indicated to be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph and rewritten in independent form.

The Indefiniteness Rejection

This response amends claim 22 so that it depends on claim 19 instead of cancelled claim 21. Claims 23-32 depend on amended claim 22, so that this amendment provides those claims with the correct parent independent claim as well. This amendment is accordingly believed to correct the indefiniteness that formed the basis for the rejection under 35 U.S.C. 112, second paragraph.

The Rejection based on Arnold in view of the PenCAT

Claims 1, 9-12, and 15-19, 22-25, 29-32 were rejected under 35 U.S.C. 103(a) as being unpatentable over Arnold in view of the PenCAT. Reconsideration is requested.

In independent claims 1 and 19, applicants set forth "storing point data defining the positions of a plurality of feel points that model the surface of a dental tool" (claim 1) and "tool

definition data for representing the position of feel points on the surface of a dental tool in three-dimensional space" (claim 19). The Arnold reference nowhere suggests that the surface of a dental tool is or should be represented by a plurality of feel points.

Independent claims 1 and 19 further respectively require the performance of the step of "employing a digital computer consisting of a processor and a display device to display said model of a tooth" and "a simulation program executable by said processor in response to the movement of said stylus for moving a displayed model of said dental tool with respect to a displayed model of said tooth." Again, Arnold nowhere suggests that the model of the tool represented by plural feel points be displayed. Arnold describes a "haptic viewer" which provides "an almost solely touch oriented interaction as the only visible data is a wireframe representation of the force mesh * * * This enables the user to see the original model [of the tooth] while feeling the force mesh through the PenCat." See Arnold, bottom of page 601 to top of page 602. Thus, it does not appear that experimental device described by Arnold in Section 5 at pages 600-602 displayed any representation of the tool at all, and certainly not a model of a dental tool whose surface is represented by the positions of a plurality of feel points as claimed.

Still further, independent claims 1 and 19 call for "employing said processor to compare said location of at least one isosurface in said model of a tooth with said positions of said feel points that model the surface of a dental tool to calculate and apply computer-controlled interaction forces to said force-feedback stylus to simulate the feel of said dental tool to haptically simulate a dental procedure" (claim 1) and for "a simulation program executable by said processor in response to the movement of said stylus for moving a displayed model of said dental tool with respect to a displayed model of said tooth and for comparing the position of said feel points to the position of said volume elements for calculating and applying computer-controlled interaction forces to said force-feedback stylus to simulate the feel of said dental tool to haptically simulate a dental procedure." Arnold nowhere suggests that interaction forces applied to force feedback stylus be calculated by comparing the positions of feel points on the surface of a tool model with position data describing the surface of a tooth model as claimed.

Because Arnold fails to disclose of suggest employing a tool model which comprises data representing the positions of plural feel points on the tool's surface, fails to disclose displaying that tool model, and fails to disclose generating feedback forces by comparing the positions of the plural feel points with the position of a modeled tooth surface, there is no basis for

concluding that the subject matter set forth in independent claims 1 and 19 (and the remaining dependent claims) would be obvious in view of Arnold and the PenCAT.

The cited PenCAT disclosure describes how that device can be used to feel objects being designed, but does not suggest that the device can be used to manipulate the model of a three-dimensional tool whose surface is represented by a plurality of feel points, or that such a tool model can or should be displayed, or that feedback forces applied to the PenCAT stylus can or should be calculated by comparing the positions of plural feel points of a tool surface model with the position of an object surface. Reconsideration of the rejection of independent claims 1 and 19, as well as claims 9-12, and 15-19, 22-25, 29-32, as being unpatentable over Arnold in view of the PenCAT is accordingly requested.

In rejecting dependent claim 9, the Examiner suggested that Arnold discloses that "a display device renders said model of a tooth and said model of a dental tool in a stereoscopic three dimensional display", citing P. 598 at ¶ 3.1-3.2. An inspection of the cited sections of Arnold reveals, however, that it describes obtaining or artificially creating data for tooth models, and says nothing about representing models of tools, and further says nothing about representing either a tool or a tooth in a stereoscopic three dimensional display as set forth in claim 9. Reconsideration of the rejection of claim 9 is accordingly requested.

In rejecting dependent claim 10, the Examiner suggests that Arnold discloses a simulated dental procedure comprising a haptic interface device that is manually moveable by a dental student and includes a moveable hand piece that is moveable in at least three degrees of freedom, citing Arnold at page 601, top of page. In fact, Arnold specifically states that the PenCAT device can move in only two degrees of freedom. Further, at page 602, Arnold states that "using devices [with more than two degrees of freedom] would require a completely different interaction approach, as currently there is no standard interface for them." It is submitted that applicants have provided such new interaction approach, as set forth in independent claims 1 and 19, by modeling the tool surface with a plurality of interaction points and calculating the interaction forces by comparing the tool surface feel points with the position of the tooth surface.

In rejecting dependent claim 12, the Examiner asserted that Arnold discloses model of a tooth is subdivided into different regions simulating different materials of a tooth, including pulp tissue, citing P.597, ¶ 2. The cited section of Arnold describes the difficulties faced by a dental practitioner in performing procedures on different portions of a tooth, but does not disclose or

suggest anything about the makeup of a data model for representing the different materials in teeth. This response amends claim 12 to more definitely set forth this aspect of applicants' invention. While Arnold does describe a tooth data model that depicts surface contours within the tooth, there is no suggestion in Arnold that the tooth include data which designates different material types of different regions within the tooth as set forth in claim 12 as now presented.

With regard to claim 17, the Examiner stated that Arnold discloses the step of responding the movement of the model of a dental tool with respect to the model of a tooth by modifying volumetric object grid data in the tooth model, citing page 601. However, a careful reading of that page reveals that it only describes the manner in which the force feedback applied to the PenCAT device can simulate the feel of an object, but nothing is said about modifying data describing the felt object in response to the movement of the PenCAT stylus.

In rejecting claims 18 (which is dependent on claim 17) and claims 22-23, The Examiner states that Arnold discloses means for storing data for representing the shape and character of a modification region (collision detection) of the model of a dental tool to control the manner in which the volumetric object grid data is modified, citing P. 601-602; P. 603, ¶ 7). It is submitted that nothing in the cited passages suggests representing the shape and character of any part of a dental tool with stored data, and nothing suggests modifying the data representing the tooth in response to the movement of the dental tool model as claimed.

Regarding claim 25, The Examiner states that Arnold discloses a simulated dental tool comprising feel points defined for a stylus on the basis that, although not explicitly stating that the feel points define a handle portion, the feel points must include a handle portion since the stylus is grasped by a user's hand. Reconsideration is requested. While the PenCAT stylus has a handle, Arnold says nothing about using data to model the surface of any part of a tool, including a handle portion, let alone modeling the tool with a plurality of feel points which are positioned on the tool's surface, including a handle portion as claimed. In Arnold's system, the PenCAT stylus moves the location of the stylus tip in two degrees of freedom but there is no suggestion anywhere that a data model of any part of the shape of any tool is stored or used as claimed.

In rejecting claim 29, the Examiner asserts that Arnold discloses a method wherein some of the feel points are positioned relative to a modification region to guide the movement of the modification region with respect to the tooth model, citing page 603, ¶ 7. That passage says nothing about feel points, nothing about a modification region of the tool, nothing about guiding

the movement of the modification region with respect to the tool model. Instead, that passage suggests only that "future work" may create devices in which the user can "feel as he sees the instrument being directed through the root canal." This cited passage of Arnold does not purport to teach anyone how to do that, nor does it describe the instrumentalities that will be used in the future to make that possible. Moreover, the cited passage does not describe or suggest that the movement of a modification region on the tool with respect to the tooth model may be used to modify the tooth model as it moves. Hence, the cited passage of Arnold is not an enabling disclosure of anything, nor does it even suggest that the subject matter claimed should be a goal for future work.

In rejecting claims 30-32, the Examiner suggests that Arnold discloses tool definition data that includes a specification of location of sensor points relative to modification region for determining attributes of volume elements, citing pages 603-603 (sic.). Reconsideration is requested. As discussed above, Arnold does not suggest "tool definition data" of any kind, including a plurality of feel points (as discussed above). Moreover, nothing in the Arnold teaching suggests sensor points used to sense the attributes of volume elements (which are also not suggested or disclosed by Arnold).

The rejection based on Arnold in view of PenCAT and Hayka

The Examiner rejected claims 2-8 and 13-14 on the basis that Arnold discloses a system that simulates a dental tool for performing a root canal procedure, citing page 603, ¶ 7. In fact, Arnold in the cited passage suggests only that future work may enable a user to feel as he moves an instrument is being directed through a root canal. Arnold does not suggest that anything as ambitious as simulating a root canal procedure, does not describe anything capable of performing such a simulation (which would necessarily include the simulation of the removal of portions of the tooth model), and notes that an attempt to use haptics in this environment "with throw up additional network and system challenges."

The Examiner further concedes that Arnold does not disclose that the simulated dental tool is a pick (as per claim 2), drill (as per claims 3 and 13), amalgam carrier (as per claims 4 and 14), carver (as per claim 5), and combinations thereof (as per claims 6-8), the Examiner states that it would be obvious to one of ordinary skill in the art to simulate various dental tools required for specific dental operations. It is submitted, however, that Arnold does not simulate

any kind of dental tool. Instead, Arnold teach how the PenCAT stylus may be used to explore and feel the contour surfaces moving the PenCAT stylus tip in two degrees of freedom. Arnold does not model the shape or structure of any kind of tool. Accordingly, it cannot be said that it would be obvious to simulate any of the different tools specifically claimed.

Hayka doesn't provide the teaching that is missing in Arnold. The Hayka system employs an actual dental drill together with means for varying the flow of compressed gas to the drill to vary its speed of rotation to simulate drilling a real tooth having regions of different hardness when drilling an artificial tooth whose hardness does not vary. Hayka nowhere suggests or discloses that the dental tool be modeled by storing data defining a plurality of feel points that model the surface of the dental tool, or that the processor compares the positions of these feel points to the locations specified by the tooth model data to calculate and apply computer-controlled interaction forces to a force feedback stylus as now set forth in independent claims 1 and 19 as amended. Hence, there is nothing in either reference that suggests that modeling a dental tool of any kind with data as claimed and certainly no suggestion of the combinations set forth in the rejected claims 2-8 and 13-14.

Finally, with respect to claim 16, the Examiner again suggests that Arnold discloses the step of responding the movement of the model of a dental tool with respect to the model of a tooth by modifying volumetric object grid data, citing page 601. It is again pointed out that Arnold nowhere suggests a data model defining the shape of a dental tool, moving the dental tool model relative to the model of the tooth, and modifying the data model of the tooth in response to that movement as claimed.

Allowable Subject Matter

The allowability of claims 26-28 if rewritten in independent form is noted. For the reasons submitted above with respect to the allowability of these claims' parent claims 19, 22, 23 and 24, there is not need to write them in independent form.

Conclusion

Reconsideration and allowance of claims 1-19 and 22-32 in view of the foregoing amendments and remarks is respectfully requested.

Respectfully submitted,

Dated: April 25, 2005 Charles G. Call, Reg. 20,406

Certificate of Transmission under 37 CFR 1.8

I hereby certify that this *Amendment* is being transmitted by facsimile to (703) 872-9306 on April 25, 2005.

Dated: April 25, 2005 Signature _____

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